sending always to the Railroad Journal one of the first copies of their reports when published. Have the other Massachusetts companies made their annual reports yet? If yes—where are they?

We find in "The Civil Engineer and Architect's Journal," for January 13th last, the following statements, in relation to the use of wrought and cast iron for bridges. The wrought iron bridges are after the plan of "the wooden lattice bridges of America;" the origin of which style, the editor claims for "the late Mr. Smart of Westminister wharf, Lambeth." Possibly this may be the fact—but if so, the Americans have probably made some important improvement upon the original. Will those interested in the subject in this country give up their claim—or will they furnish us their statement for publication? We should like to publish an accurrate account of their origin in this country, but must rely upon those who posses the facts to furnish them.

The following papers were read before the Institution of Civil Engineers—January 9th, 1844.

By Capt. W. S. Moorsom, Assoc. Inst. C. E., descriptive of a cast iron bridge over the Avon, near Tewkesbury, on the line of the Birmingham and Gloucester railway. The principal novelty of this work, which was proposed, and its execution superintended by Mr. Ward, of Falmouth, is the mode of constructing the two piers, which were externally of cast iron in the form of caissons, each weighing about 28 tons; the plates composing each caisson were put together on a platform erected upon piles over the site of the pier, the bottom of the river being levelled by a scoop dredger, the caisson was lowered, and some clay being thrown around the exterior, a joint was formed so nearly water tight, that two small pumps drained it in six hours. The foundation being thus excavated to the requisite depth, the caisson, which sank as the excavation proceeded, was filled with concrete and masonry; cap plates were then fixed for supporting eight pillars with an entablature, to which was attached one end of the segmental arches 57 feet span, with a versed sine of 5 feet 2 inches. There were three of these arches, each formed of six ribs of cast iron, and two such piers as have been described, the land abutments being of stone work joining the embankment of the railway. It was stated that this mode of construction was found to be more economical in that peculiar situation than the usual method of fixing timber cofferdams, and building the piers within them; the total cost of the bridge being only £10,198, and the navigation of the river was not interrupted during the progress of the work. The paper was illustrated by eighteen remarkably well executed drawings by Mr. Butterton.

A paper by Mr. G. W. Hemans, Grad. Inst. C. E., descriptive of a wrought iron lattice bridge erected across the line of the Dublin and Drogheda railway was then read. This bridge, which in construction is similar to the wooden lattice bridges of America,* only substituting wrought iron for timber, is situated about three miles from Dublin over an excavation of 36 feet in depth; its span is 84 feet in the clear, and the two lattice beams are set parallel to each other, resting at either end on plain stone abutments built in the slope. These beams are 10 feet in depth, and are formed by a series of flat iron bars 2 1-2 inches wide by 3-8 inches thick crossing one another at an angle of 45 degrees; at 5 feet 6 inches above the bottom edge, transverse bearers of angle iron are fixed similar to those now used for supporting the decks of iron steam vessels, and upon those the planking for the roadway is fastened. The account of the mode of construction, and of the raising and fixing the lattice beams, by Messrs. Perry, of Dublin, the contractors, was given in detail, and the author stated that, although it was expected that considerable deflection would occur, which was provided for by forming the beams with a curve of 12 inches in the centre they did not sink at all even when heavy weights passed over them. The total cost of the structure, including the masonry of the abutments was £510. It was stated that this bridge had been erected by Mr. Macneill, M. Inst. C. E., in order to test the soundness of this kind of structure before he applied it in a bridge of 240 feet span to carry the Dublin and Drogheda railway over a canal.

* The original inventor of the lattice bridge, was the late Mr. Smart, of Westminister bridge wharf, Lambeth, who many years since took out letters patent for the principle.—(Ed. C. E. & A. Journal.)

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For the American Railroad Journal and Mechanics' Magazine.

COST OF TRANSPORTATION ON RAILROADS.—BY CHARLES ELLET, JR., C. E.

(Continued from page 8.)

Wear of Iron Rails.—It was not my intention to deviate from the course which I had marked out as proper to be observed in the discussion and development of the important subject which I have attempted to exhibit, for the purpose of disposing of collateral points, or of refuting any objections that might be urged against my argument. But the matter presented in the December number of the Journal is of such deep interest to all concerned in the railroad cause, that I have been compelled to make frequent oral explanations and estimates, which could be more advantageously and more appropriately offered in their place in these articles. I propose, therefore, to recur briefly in the present paper, to the momentous question of the probable durability of the iron rails, and the pecuniary loss consequent on their destruction, for the purpose of presenting facts which it was my wish to postpone to a later period.

It is as impossible as it would be dishonest to attempt to promote the cause of internal improvement, or any division of that cause, by deceptive estimates or the expression of extravagant hopes. It is the duty of the engineer, as well as of the statesman, to look at things as they are, at this great system as it is. He must first recognize the weaker points before he can hope to fortify them. If companies or their officers, fail to estimate their expenses truly, they will inevitably fail also in their great objects; and instead of bringing blessings and prosperity into the country, public improvements will continue to be, as they have hitherto frequently been, the bearers of private ruin and public dishonor.

The prevailing fault of nearly all writers on railroad policy is that of yielding up their judgment to the dictation of their wishes, and exhibiting the facts as all desire them to be, and not as we find them. Hence the proverbial errors of companies and their agents, in undervaluing the first cost of their work; in over estimating its business, and underrating the cost of its maintenance. Their opinions are but the picture of their hopes, and rarely deductions from an extensive and systematic investigation, and a wide experience.

But we are now in pursuit of truth and shall endeavor to avoid this error.

The railroad system is new. It is not yet twenty-five years since the locomotive engine has been used with any decided success, and it is not fifteen years since its first employment on lines of general and extensive intercourse.

We have, nevertheless, much experience of the wear of iron rails; for a heavy trade—a trade vastly inferior to that of some of the canals of this country—is sufficient to produce great and obvious effects in a very brief space of time.

We cannot seek this experience, however, on the great railways recently finished in England. These carry but little freight. Their business is nearly confined to the conveyance of passengers; and though they really transport many tons of parcels and costly merchandize, and make a considerable show of business, the actual tonnage, compared with that of some of our important canals, is insignificant. Indeed, the public have not yet become accustomed to compare the actual weight of the trade which is transmitted along existing lines of railroads, and that which passes noiselessly through the old canals, and there are consequently few who have yet formed a just conception of their relative magnitudes.

The *London and Birmingham* railway has already cost about $30,000,000; and was graded with a view to the heaviest traffic; but the speed and accommodation which it offers are but slight compensation for the price of carriage at which they must be purchased. With all the labor bestowed upon this work; with all the outlay encountered to reduce the cost of transportation—the annual nett tonnage upon it is not greater *than five or six weeks' trade of the Schuylkill navigation.*

The *Great Western* road has cost some $32,000,000. The nett tonnage upon this line is still less than that upon the London and Birmingham. It does not reach 120,000 through tons per annum.

But the traffic upon these works, light as the tonnage is, has been sufficient, at the high velocity permitted, to produce great destruction.

The former commenced with two tracks of edge rail of fifty pounds per yard, and wore much of it out before the line was finished.

The latter commenced with a forty-four pound bar between London and Maidenhead, and had rendered it unfit for safe service nearly a year ago. The still heavier iron which they are now using is not, of course, yet entirely destroyed. But before this time next year—if my calculations do not fail—I shall produce evidence in this Journal, that a portion of these seventy-five pound bars, has also given way under less than 500,000 tons nett.

At present, however, I will confine myself to past experience, and endeavor to ascertain from *that* what sort of expectations we have a right to entertain for the future. The new English roads have added but little to our previous information on this head; but still we are not without a great deal of valuable experience; and it is the duty of those who seek for truth, and who seek to exhibit it to others, to profit by the best experience they can find.

In reference to the subject before us, we know,

1st. That some eight or ten of the railroads of this country, have worn out the common half-inch flat bar, with an average aggregate trade of 150,000 tons nett, drawn by locomotive engines.

2d. The Camden and Amboy road has, in places, worn out an edge rail weighing about 40 pounds per yard, with a trade considerably less than 400,000 tons nett.

3d. The edge rail on the Columbia road, weighing 33 pounds per yard, has not yet borne the passage of 350,000 tons on one track, and is nearly destroyed.

4th. On the Boston and Lowell road, a 36 pound rail was so much injured, or so much weaked, as to need renewing and replacing before it had sustained the passage of 600,000 tons nett.

5th. The Liverpool and Manchester road was opened in 1830. In 1835, the *first two tracks of edge rails*, weighing 35 pounds per yard, were destroyed and renewed; and the trade was less than 600,000 tons nett, on each track.

6th. In 1835, the Liverpool and Manchester company relaid the portion of their road next to Liverpool, with edge rails, weighing 50 pound per yard—or just five pounds per yard heavier than those of the Reading railroad. Before the close of 1840, these *new rails* (weighing, I say, 50 lbs. per yard,) were worn out, and taken up, and substituted by two other tracks of iron, weighing 64 pounds per yard. These 50 pounds per yard rails were destroyed by about 700,000 tons nett on each track. So that, in the brief space of nine years, this company destroyed four successive single tracks of edge rails with an average nett trade of about 300,000 tons per annum.

7th. The 64 pound rails next introduced on this road, were found to be *too light*, and a 75 pound pattern was substituted, which is now the adopted weight. These rails of 75 pounds have already begun to give way at unsound places—the injury "showing itself chiefly in lamination and occasional splitting at the edges."

8th. The Stockton and Darlington road, considered as a single track, has been *ironed* with edge rails from six to eight times.

Business commenced on this line about the year 1825. In the year 1834 the trade had reached 338,248 tons. In 1840 it had attained the extraordinary limit of 803,784 tons, and up to the year 1842, there had passed along the work a nett weight of nearly 6,500,000 tons. At that time six tracks had been destroyed, and taken up and replaced, besides the rails that each time were introduced, before an entire change of form was resolved on. How many tracks this patching may have amounted to, it is probably impossible now to ascertain. *The cars on this road are very light and the velocity but six miles per hour.*

It is probable that each track of this road has sustained nearly 1,000,000 tons; and with such cars, and at such a moderate speed, it is not impro-

bable that a 50 pound bar would sustain from 1,200,000 to 1,500,000 tons.

9th. The London and Birmingham 50 pound iron which was destroyed before the work was finished, sustained about 350,000 tons on each track. The velocity here was, however, exceedingly great, and the cars unusually heavy.

10th. The nett tonnage on the Great Western road, which destroyed the 44 pound iron, did not reach 300,000 tons of freight and passengers per track. The engines and cars are still heavier than those of the London and Birmingham road, and the average speed 25 miles per hour.

Now, these are facts; and this, whatever it is worth, is *experience*. The intelligent reader must judge from the facts, whether or not the cost of renewing iron ought to be regarded as one of the current expenses, or as a thing so extraordinary as to require to be excluded from the annual charges altogether, and added, as is now the universal custom, from year to year, to the cost of the road.

But the rapid destruction of iron under the action of a heavy trade, and the measure which, in the December number, I have assigned to its durability on the Reading road, where the velocity is from ten to fifteen miles per hour, is now but faintly denied; or, if denied at all, only by inexperienced parties, and in anonymous communications.*

A new view is accordingly taken of the subject, and the important question arises to determine the amount of loss to the company consequent on the destruction of the iron. I mean to offer no conjectures on this head either, but refer to known and admitted facts, as a guide to my conclusions.

I find in the last report of the Boston and Lowell railroad company—the only company in this country, which has renewed a considerable portion of a track of edge rails in one year, and published the cost—the following charge:

"For labor and sundry materials, in taking up twenty miles of track laid with 36 pound rails, and replacing it by rails of 56 pounds per yard, exclusive of the cost of rail iron, $34,162 09." The year before the expenditure for this object was $14,608, so that for changing 25¼ miles of edge rail, the company incurred an expense of $48,770, or $1,900 per mile.

There are seventy-one tons of rails in a mile of the track of the Reading railroad, and the cost of taking up the old iron and putting down new, is, therefore, $1,900 for 71 tons = per ton, - - $26 75.

A ton of new iron delivered in Philadelphia, will cost under the present tariff, - - - $60 00

The old iron is supposed to be worth along the line, per ton, about - - - - - 25 00

Difference between the value of new iron in Philadelphia, and old iron on the ground, per ton, - - $35 00

* Since this was printed I have received the last number of the Railroad Journal, in which I find my views entirely disputed.

The cost of changing the iron track of the road will then be as follows:

Seventy-one tons of iron, taken up and put down, at $26 75,		$1,900
Difference between 71 tons of new iron bought at $60,	$4,260	
And 71 tons of old iron sold at $25,	1,775	2,486
Seventy-one tons of new iron transported to, and distributed along the line at $5,		355
Cost per mile of changing iron,		$4,740

This sum of $4,740 will be the amount due to the trade which will destroy the iron, or render it unfit for safe usage. I know of no iron which has yet withstood the action of a million tons; and I know of no iron of 50 pounds or less, that is likely, at the usual speed in this country, to resist that weight. If we consider the rails of the Reading road to be capable of that effort, then we shall have 4¾ mills per ton per mile for the value of the iron destroyed by each ton of coal descending the line: or 44½ cents per ton for the whole distance of 94 miles. By adopting the rates of speed of the Stockton and Darlington road, it is probable that the cost of the iron could be brought down to 60 cents per ton, or near that limit; but if the company adopt the heavy cars, (7½ tons when loaded) and powerful engines, and heavy trains now contemplated, and continue the high velocity now permitted, the destruction of iron will probably be scarcely compensated for by seventy-five cents per ton.

This is a calculation from such data as we are able to obtain. But was there ever a calculation of such work, which was not exceeded by the practical result? One of the data assumes that there will be as many tons of iron to sell, as were originally bought. But the weight will not hold out. It is useless to inquire why; yet we cannot spread 70,000 bars of iron along a road 100 miles in length, and beat them and roll them for one or two years and then collect them all again. This is a practical difficulty which must always be encountered under such circumstances. The calculation assumes that it will not be collected; and, besides, that the 140,000 bolts, and the 70,000 chairs to be distributed and replaced, can likewise be found again.

Many visionary estimates have been made on this head, by parties of little experience in the handling of heavy materials, and in the performance of mechanical work; but the following practical facts are a great deal more forcible, and will be found to furnish data which can be applied with much more certainty than any speculative estimate whatever.

The *South Carolina* railroad was opened in the year 1833; the trade averages about 25,000 tons. In the semi-annual report for December 31st, 1838, five years after the completion of the work, we find the following:—"deduct the following expenditures, as being rather for permanent improvement than current expenses, viz:

Machiney,	$26,888 12
Spikes,	4,582 34
New rail iron,	3,940 00 etc.

This hint to the experienced reader, is symptomatic of the contents of the next report, (June 30th, 1839,) from which I extract the following:

"Amount paid for rail iron in Charleston,	$371,679 12	
Less old iron *sold and unsold*, - -	92,902 27	$278,776 85
Cost of transportation of the same on the road, and laying down, including spikes, - - -		74,400 00
Nett cost of new iron, - - -		$353,176 85"

Here we perceive that the entire sales of the old iron (when it was all disposed of, it yielded precisely $92,325 71,) exceeded the cost of putting the new rail in the track, but by some $18,000, while the nett cost of the new iron, after deducting the proceeds of sales, was $353,176. Such is in fact what is to be expected. *The old iron will barely pay for putting down the new, and the loss to the company will be about equal to the cost of the new iron delivered at the sea port.*

A writer in the Railroad Journal proposes a scheme for the Reading railroad to *make money*, by procuring rails free of duty, and selling the old material, after it has been worn out, with the advantages of the duty.

The operation was conducted under precisely those circumstances on the South Carolina road; but the above balance will show that the speculation did not turn out so well in that case. Indeed I have known many instances in which the iron has been renewed, but I have never heard of a company, here or abroad, that found the speculation a profitable one.

In the accounts of the South Carolina road, the new iron is charged to "permanent improvements," (the old iron lasted *five* years) and the company recommenced with augmented capital.

I have but one word to add in reference to the durability of iron rails, subjected to the action of a trade like that of the Schuylkill. I have already stated that if the Reading railroad company expect to obtain the whole trade of the canal, they must prepare for the entire renewal of a single track every year; and I now add, *if the company carry* 500,000 *tons of coal during the present year*, as they now propose to do, the new iron cannot be put down, before that now on the track will be so nearly destroyed as to be unsafe.

It is understood that this company has recently obtained an additional loan of $1,000,000. With this it is proposed to stock and equip the line, and procure the additional track, and prepare for the conveyance of the whole trade of the Schuylkill.

I therefore advance this additional proposition. After this money is expended, and the company shall have put themselves, by its aid, in the position which they seek to occupy, they will neither, in the first place, be able to carry more than *half the tonnage* of the Schuylkill, and, in the second place, if they succeed in obtaining half the tonnage, they will not be able to engage vigorously in the business of 1845, without a *new loan* of a million of dollars; and, finally, if they continue to operate through the present and the next year, they cannot engage in the business of 1846, without another loan

of at least one million. In short, waiving all regard to interest on their capital, it is *impossible for them to carry the Schuylkill coal trade, without borrowing one million of dollars per annum.* And when they cease borrowing they must cease carrying. I now dismiss the consideration of a road, which, in my opinion, was most unwisely commenced—which has been prosecuted in folly, and which can only terminate in disaster. On this result I desire to rest my claim to the public confidence.

Additional application of the formula.—In the November number of the Journal, I offered a formula for the computation of the annual expenses of lines of railway, and exhibited its application and agreement with the actual results on seventeen of the most important roads in the country.

The greatest deviation of that formula from the actual result was 12 per cent., which occurred in the case of the Baltimore and Ohio railroad for the year 1841.

In speaking of the deviations, I added these words: "It will probably be seen, on some future occasion, that those roads which now exhibit expenses above the formula, will fall below it for other years; a remark which is applicable to the *Boston and Lowell, Baltimore and Ohio and South Carolina roads.*" Since the publication of that article, I have received through the politeness of Mr. Latrobe, the able engineer of the Baltimore and Ohio railroad, the report of the operations on that work, for the year 1843, together with some valuable manuscript details, of which I hope to make useful application in the further prosecution of my present study. I am also indebted to Charles S. Storrow, Esq., the valuable superintendant of the Boston and Lowell road, for similar statistics in relation to the excellent, and, I believe, prosperous work under his charge, in anticipation of the publication of the report. I have also received from Mr. Storrow similar information relating to his line, for the year 1841, which I had not before obtained, and from the report of the Baltimore and Ohio railroad company, I find the facts necessary for the application of the formula also to the Baltimore and Washington road for the year 1843.

These results have all been procured since the publication of the formula; and I therefore proceed to test it by making the application to those lines.

It will be recollected that I offered, in the first place, a formula for the determination of the expenses for a *new line*, viz:

$$\frac{24\,N}{100}+\frac{9\,T}{1000}+\frac{7\,P}{1000}+300\,h.$$

And in the second place, a rule for the computation of the expenses of maintaining an old road, or road which had been opened more than four years, viz:

$$\frac{27{\cdot}5N}{100}+\frac{14\,T}{1000}+\frac{7\,P}{1000}+500\,h.$$

In both expressions, N stands for the number of miles run by the locomotive engines; T for the *tons nett* conveyed one mile; P for the number of passengers conveyed one mile, and h for the length of the road in miles.

In applying the formula to the Baltimore and Ohio road, it is to be borne in mind, that of the 178 miles in use for the year 1843, but 82 miles were opened previous to 1842, and that the whole of the remaining 96 miles is *new road.*

The result of the application to these several lines is exhibited in the three following tables:

TABLE.

Name of Road.	Year.	Length in miles.	Grades.	Miles run by trains.	Through tonnage.	Through travel.	Actual expense.	Calculated expenses.	Error per cent.
Boston and Lowell,	1841	26	10	125,296	90,113	170,057	$119,469	$111,207	
Boston and Lowell,	1842	26	10	143,607	93,927	179,819	131,012	119,409	
Boston and Lowell,	1843	26	10	134,982	114,711	176,537	109,367	124,004	
Aggregate for these three years.				403,285	298,751	526,413	359,848	354,620	1 1-4

It will be recollected that I anticipated, in the November number, that subsequent results would be more favorable to the Boston and Lowell road, than that of 1842. We here find it so. In 1842, the formula fell $11,603, or 9 per cent. *below* the actual expenses. In 1843 the calculated expenses rise $14,637 *above* the actual expenses. But my remark in the December number should be recollected in these comparisons:—"The formula exhibits what it was intended to show—the average for a number of years." And hence, we have another test. The aggregate expenses on the Boston and Lowell road for three years are, as we observe by the table, $359,848. The calculated expenses, $354,620. This is surely close enough.

Again, we will take the Baltimore and Ohio road, for the year 1843, for the purpose of an additional application.

TABLE.

Name of Road.	Year.	Length in miles.	Grades.	Miles run by trains.	Through tonnage.	Through travel.	Actual expense.	Calculated expenses.	Error per cent.
Baltimore and Ohio,	1841	82	82 1-2	299,617	44,477	34,390	$220,135	$192,925	
Baltimore and Ohio,	1843	178	83 1-2	509,765	39,619	33,670	287,153	322,075	
Aggregate expenses for two years,							507,288	515,000	1 1-2

I have taken no notice of operations on this work for the year 1842, because during that year the line was opened, in parts, from Harper's Ferry to Cumberland.

The application for the year 1841, gave a result of $27,210 *below* the actual expenses. I stated at the time that the subsequent expenses would be likely to fall *below* the calculated expenses. We accordingly find the result for the next year comes $34,000 below the formula. Here, then, is another and most conclusive confirmation of the correctness of the formula, and of the principles on which it is founded. If we take the *sum* of the expenses for the two years, we find the calculation $515,000, and the fact $507,288.

But we have yet a third case: the Baltimore and Ohio railroad report for 1843, exhibits, as has been stated, the results on the Baltimore and Wash-

ington road, likewise for that year. These, together with those of 1841 and 1842, are presented in the following

TABLE.

Name of Road.	Year.	Length in miles.	Grade in feet.	Miles run.	Through tonnage.	Through travel.	Actual expenses.	Calculated expenses.	Error per cent.
Baltimore & Washington,	1841–2	30 1-2	—	91,428	27,369	114,260	$73,684	76,166	—
Baltimore & Washington,	1843	30 1-2		96,716	26,470	86,880	68,866	71,676	4

Here is an agreement within four per cent.

When I presented this formula in the November number of the Journal, and exhibited its application to seventeen lines of railway, I stated that these seventeen lines *were all the roads for which I had been able to collect the statistical information necessary for the application.* I had written to many companies, and had generally been supplied with the facts required, and which were not given in their reports. In some instances, however, they were unable to furnish the information which I needed; in two instances I received no reply to my letter; and in one—and I am happy to say one instance *only*—the officer declined making the affairs of the company public.

Since then the three companies above named have published their reports; and *they are the only reports for the year* 1843, which I have yet received. These reports add confirmation to the previous proof. Still I advance the formula as an approximation only, which I hope, with the aid of my professional friends, and future facts, so to modify and improve, as to render its application general and certain. It is the expression of the true LAW; but the *constants* are to be built up by multiplied facts, until there can no longer be room to doubt its indications.

I have endeavored, so far, to conform to the method which modern science points out as proper to be pursued in practical inquiries. Much injury has been inflicted on the great cause of internal improvement, and especially of railroad improvement, by the erroneous opinions of enthusiastic, but unwise advocates. But a new order of things has grown up, and a new system of inquiry is rapidly gaining ground. The seed of true principles has been sown, and the roots have struck deep into the soil of this country. Under the control of these principles, and the direction of cool and honest advocates, the railroad cause will take fresh growth, and flourish with a vigor and healthfulness which it has not yet exhibited. Some visionary and extravagant projects, which are now bearing heavy upon it, will sink under the pressure of their own weight, and serve, even in their ruins, as salutary guides for the future.

During the transition, TRUTH will be for a time obscured, and possibly borne down; but it cannot be overcome. It is sustained by a power which is invincible. Truth makes no compromise of principle—yields nothing for the sake of present popularity—contributes nothing to the cause of public deception—and moves fearlessly, surely, and, in the end, all-powerfully, to its mark.

[NOTE.—In the January number of the Journal, I offered an estimate of the probable expenses on the Reading railroad for the year 1843, in anticipation of the publication of any facts on that subject: assuming the travel at 40,000 passengers, and the trade at 250,000 tons. This estimate was $265,000. I regret to find, on perusing the last report, that the company have not thought it expedient to publish their expenses for the *whole year*; but have preferred to exclude the last month, along with the heavy bills which the close of the year usually brings with it. The expenses published, for eleven months, amount to $221,060 89. I should have been exceedingly gratified to know the amount of expenses for the whole year.

The indebtedness of the company since the date of the previous report of January 1, 1843, has been increased, $1,252,659

The receipts for the first eleven months of the year amount to, 385,195

Aggregate expenditure for eleven months, $1,637,854

A statement of the *items* which have consumed this enormous sum would certainly be read with interest and instruction; and it is greatly to be regretted that at this particular period, when the public are exceedingly anxious for truth and information, the directors have deemed it imprudent to publish it.]

NOTE.—The writer has expressed his opinions on an important subject without reserve, or concealment; should his *facts* be publicly disputed, or conflicting facts be presented, by any of his professional brethren, he trusts that they will have the consideration to do it over their own signatures, that he may have the guarantee of a name for the facts which *they* contribute. He will be found as frank in correcting his errors, if he has committed any, as he is sincere in the expression of his opinions.

(To be continued.)

For the American Railroad Journal and Mechanics' Magazine.

GENTLEMEN: On the receipt of the December number of your Journal, I immediately transmitted through the postmaster of this place, the sum of two dollars, for my subscription for 1844. My last payment was in November, 1842, of five dollars, for the year, from July 1, 1842, to June 30, 1843; but the change in the times of publication made this amount to cover the time up to December 31, 1843, as I understood. Am I right?

On the subject of the establishment of a society of civil engineers, I have a suggestion to make, which appears to me plausible, and much more facile in its execution than any other which I have seen proposed. The National Institute, for the promotion of science, established in the city of Washington, is now fully organized, and in most successful operation. It is organized into various departments: as the department of geology and mineralogy—of botany—of agriculture, etc. Many of the engineers of the United States are members of this Institute. Now, why should not the engineers generally, throughout the country, become members, and organize, (for this is a part of the plan of the Institute, if I understand aright,) in connection with the other departments, a "department of engineers." The advantages of this plan may be easily seen. The United States has comparatively a large

body of engineers in its employ—for independent of the two military corps, numbering, I believe, some 84 officers, there are numerous civil assistants and agents superintending the public works (I refer to all civil constructions —such as the improvement of harbors, rivers, building light houses, etc.— carried on by the government) in employ. The information which these gentlemen could furnish, as to prices of labor and materials, and plans of construction, under peculiar circumstances, of local works, etc., if properly embodied, would be of infinite service to the profession. All these gentlemen, being members of the institute, would give their hearty co-operation in forming the department of engineering. Washington city possesses many advantages over other places, for the meetings of the society. Although the States and private companies have in most instances carried on their works independent of the government, (that is, without its pecuniary aid,) yet the presence of some one officer of each work, has, at some time in each year, been required at the seat of government, to transact business in connection with their work, at the departments. This business could be transacted much more readily through the engineer of the work, more particularly when his connection with the institute will give him an acquaintance with the locality and means of obtaining every species of information that may be turned to advantage on the work on which he may be engaged. The existence, too, of the patent office there, where all new mechanical inventions are to be found, many of which are of great importance to the engineer, will prove a great inducement to them.

Another point. It is generally known that works on engineering, and the abstruse sciences connected with it, are high priced, they being generally the productions of foreign engineers and men of science, and published in Europe, and but few copies, comparatively, ever imported to this country. On account of their costliness, and the expense of transporting them from station to station, (for there are but few of our profession that can ever permanently locate themselves in one place, and have a "*home*," but must move from point to point, as the progress of the work on which they are engaged advances, or in search of new employment,) not many engineers can ever form for themselves a library, their low salaries and the heavy expense to which they are always subjected being another obstacle. In their visits to Washington this loss can be in a great measure removed, by the library of congress, and the libraries of the war department and the bureau, where copies of most of these works will be found, and the known courteousness of the officers, in whose charge they are placed, will render them at all times accessible to the profession. The library of the institute will soon be large enough to offer advantages to the man of science sufficiently ample to warrant the spending of some days within its walls, independent of the attraction of the museum, botanical gardens, etc.

Then as to the meetings of the department of engineering. Under the by-laws of the institute, each department holds its meetings independent of the general meetings of the institute. Now the objections to an independent

society of civil engineers are the most strongly developed on this one point —the almost utter impossibility of getting a sufficient number of the members together at the place of meeting to form a quorum. Under the organization I propose, one-fourth or one-third, (or indeed any number less than a majority,) of the department may constitute a quorum to organize a meeting, at which essays may be read, and conversations held on subjects connected with the profession; while the constitution and by-laws being already formed, and all changes in them being effected in general meetings of the institute, on the proposition, verbally, or in writing, of any member, there will not be the same absolute necessity of regular meetings at stipulated times as in the other case. The records of the department required to be kept of each meeting will show to those members who can only attend a few meeting, what has been previously done.

On the subject of the continuance of your Journal, one word. Although the results of these meetings of the department will be made known through the bulletins of the society annually published; yet it appears to me that the profession will require some other additional medium of communication, and that a great deal of statistical information, originating from these meetings, and from the free interchange of opinions among the members, may be promulgated to the world, which would not find its way into those bulletins. A regular monthly or semi-monthly Journal must be supported by the profession, and why not the one already established, and which has been so successfully carried on for twelve years past? Your plan of advertisements for travellers, too, is admirable. Every traveller has, time and again, felt the necessity for some such Journal, in which are concentrated notices of all lines of travel, whereby he may inform himself, before starting, of what route he can adopt to reach any given point to which business or pleasure may call him with the greatest convenience and despatch. An individual, for instance, starting from Boston or New York for New Orleans, if he adopts the sea route, knows what he has to encounter; but if he wishes to adopt the land route, he starts in entire ignorance, in most instances, of his means of locomotion, beyond some given point on his route, or its cost; nor has he any chance of determining which would be the speediest or most comfortable route for him. He may coast by railroads, steamboats, and stages along the Atlantic frontier, and the Gulf of Mexico; or diverging from this route in Maryland or Virginia, may strike the Ohio, where he will command a tolerably pleasant, and very often a comfortable and speedy journey by steamboat down the "father of rivers." Such will be the case, too, with the route through Pennsylvania. But the traveller knows not, perhaps, that an equally convenient, speedier and more comfortable route, during parts of the year, exists from Albany, through Buffalo, by the lakes, to Chicago, thence across northern Illinois by stages and steamers, (and in a year or two canal boats will vary the mode of travel through this region) to the Mississippi, where steamers await him every day for conveyance to the great commercial emporium of the south-west. Thus travellers, as well

as railroad, steamboat and stage companies, will derive immense benefit from your Journal. The proprietors of lines of travel would derive increased benefit in making their routes known beyond the mere region of country through which they pass, while the advertisements of manufacturers would make known to those interested, the cheapest and most expeditious means for repairs, etc.

In your November number of the Journal, I received a printed circular, on which I was taxed by the postmaster here with letter postage. The amount was, to be sure, very small, and on that score do not object to its payment; but the principle involved, leads me to mention that this system of circulars, (issued, too as this was, in an evasive way,) is very objectionable. To have refused to receive this circular from the office on my part, would have involved its authors in a suit by government, and a tax of five dollars, with the cost of prosecution. This I could not consent to do; yet I must protest against the system, as an imposition—and this is not the first nor the twentieth time that it has been *levied*—when it should have been paid by those who sent them. CHARLES N. HAGNER.

[The circular alluded to by our valuable correspondent was enclosed by the present editor, without a thought on his part as to the consequences, or a design, as he believes, on the part of the gentlemen who asked the favor, of dealing unjustly by others. The cause of complaint will not, however, again occur.—*D. K. M.*]

For the American Railroad Journal and Mechanics' Magazine.

Your correspondent "Y," in your February number, adverts to Mr. Ellet's *famous* plan of railways, for which the community was to be measured about as often as its individuals for their clothes, which at first were to be made as skimpy as possible and of no better material than *wood* from *head to foot*—neither safety nor comfort being necessary ingredients while *only a few travellers* were to be accommodated, but as these increased and lives only becoming of any importance *by their numbers*, stronger materials could be used, and the community, from time to time, remeasured and supplied with a new fit, as nearly conformable to its growth as the *irregular* character of this would permit, at one time standing still, and at another running up a foot in a night. This apparantly clever idea I recollect was not at the time, however, deemed feasible by you, nor has it since at all taken with the world at large, but on the contrary, it has come to be more evident that the *most substantial at the start* was the truest policy, and that *great expense* was necessary to true economy in railways. This discovery has had the good effect of preventing useless and wasteful outlay by laying them down where they were not wanted, as was often the case formerly. The railway here understood is that which is at all worthy of consideration or that accomplishes a speed of at least fifteen to twenty miles per hour.

In introducing this subject again, the evident aim of your correspondent is *to sneer* at the Reading railway, and spread as far as possible the same

sort of *slanders* against it as have lately filled the Philadelphia papers, but which happily were so gross as to lose their effect, and to fall still-born from the press—much to the mortification of their concoctors.

The impression which he would have prevail, is that the said railway in its necessarily large expenditures, gets no value therefor, and reach what they may, it can never be worth anything; or in his own words, "*its cost will be its only merit.*"

In the face of this, however, the canal he advocates as *even now* so much more efficient than this railway, has applied to the Pennsylvania legislature for leave to enlarge its capacity, as a means of better competing with this despised rival, and which it cannot do unless at a very heavy outlay, and with even then a doubtful result. Let the merit of the respective expenditures on these two works be impartially judged, and depend on it, the railway will be found to have spent nothing that has not secured to it a *more effective provision* for doing the business contended for.

The fact is, that some five or six years ago, a *notification*, then much laughed at by all the canals, was issued to such as were carriers of coal—the X pamphlet, bound in green, was the medium—that a *cheaper carrier* was then in course of construction, which, *when properly ready* would fully establish that fact. The Reading railway was here meant—which having now fairly entered the lists, the canals are found to wince already, and to vent their agonies, as before stated, in *vain abuse*, as if no warning had been given them.

When the *notification* alluded to, was issued in 1839, the cost by the canal given therein and afterwards *confirmed* by the board of trade of Pottsville, including freight at $1 28, and toll at 92 cts. per ton, with wastage, shipping, etc., was for coal, between Pottsville and Philadelphia per ton, $3 21

In that notification the *then* estimated cost by the railway in progress was 79 cts., exclusive of toll, for which may be added ½ ct. per ton per mile, say 47 cts., making the whole cost to compare with the above per ton, - - - - - 1 26

Difference as made in 1839 in favor of the railway, - $1 95

At this day, however, in 1844, when all things have shrunk in value to near a minimum, and the competition of the railway has had some influence, we find as to the main items of freight and toll, these two rivals now standing as follows:

By canal, freight 70 cts., toll 36 cts., per ton from Pottsville, $1 06

To which is to be added, agreeable to the estimate of most of the operators, since they have had experience of the railway, sundry items to the disadvantage of the canal, amounting in all to - - - - 40—1 46

By railway, now while in process of receiving the trade, the charge for freight and toll is for the present between Pottsville and Richmond or Philadelphia, - - 1 10

$0 36

making a margin of 36 cents in favor of the railway, showing that if the whole toll were remitted on the canal, the railway could still retain the trade, and will hereafter no doubt avail itself of this favorable position to raise its rate to $1 25 at least.

The consumer has come off the best in this contest, the saving to him in round numbers being about $2 per ton, or on the whole present consumption of 1,200,000 tons, say $2,400,000, which may be employed in some other purpose of use or luxury. Next to the advantage obtained by this railway, of reducing the price of coal near *one-half*, will be that of securing a *uniformity of price* for it throughout the year, worth collaterally little less than the direct reduction of cost in the business it will attract. X.

RATES OF FARE AND RATES OF SPEED ON RAILROADS.

A great diversity of opinion exists in the public mind on these two subjects connected with railroads, in relation to which, as it seems to us, great accuracy is attainable. We have resolved, in consequence, on submitting to our readers our own views in relation to them, in the hope that they may, in some degree, tend to remove the confusion resulting rather, as it appears to us, from a disposition to generalize too far, than from a want of proper observation, or any difficulty in arriving at correct conclusions.

The proposition is often broadly laid down, that every reduction of rates on travel is attended with an increase, not only in the gross, but also the nett receipts of a railroad. Of course, pushed to an extreme, it is necessarily incorrect, or we should have to arrive at the conclusion, that *no fare at all* was the best case for a railroad. The proposition is undoubtedly true, that reductions of fare have *so far*, in our country, been advantageous to the companies making them. This, however, only proves that hitherto the fares on most lines of improvement have been above, rather than below the point of greatest advantage, not that they may not be very readily too low, as well as too high.

In looking into the subject, it strikes us that there is an entire analogy between the principles which should govern in the adoption of rates of fare on a railroad, and a revenue tariff on imports. The latter may be so high as to put a stop, in a great degree, to importation, or it may lead, in exposed situations, to smuggling, or both consequences may result. In the same way, a high rate of fare may be deeply injurious to a company, by diminishing the number of travellers, on their railroad, or in the case of unprotected lines, it may induce the adoption of inferior routes, or both results may ensue. The prosperity of the line of railroad communication between New York and Washington, for example, has, we have little doubt, been essentially retarded by injudiciously high rates. Between New York and Philadelphia, the monopoly has so far been complete, and the high rate of fare has operated mainly in reducing the number of travellers between these cities, to, we verily believe, less than one-half of what it would be, were the fares placed at two-thirds the present rates, with a somewhat higher rate of speed.

But between Philadelphia and Baltimore much more serious consequences must, it seems to us, result to the railroad line between those cities, should their present rates be kept up. Located as this road is, throughout its whole extent, parallel to the Delaware river and Chesapeake bay, nothing, we should think, could prevent the competition of lines of very fast steamboats in their waters, with barges on the canal connecting them, or connecting stage lines, but such reduced rates of fare and increased rates of speed as will set all competition at defiance, while on the other hand, very reduced rates of fare and higher speed would not only prevent all competition for the present travel on the route, but greatly increase it. We trust, for the sake of railroads, that the company will be wise in time, and act on the principle of the ounce of prevention being worth the pound of cure.

We cite these two case as the most striking that present themselves to us, of error on the side of high fares. Connecting, as the roads in question do, the largest and most populous towns in our country, and these in free States, where the temptation to travel is widely increased with every reduction in rates to the laboring class, and with every increase of speed to men of business, we know of no case in which low rates and high speed whould pay so well. There are, however, but few railroads out of New England on which the fares are not too high, and the speed for travellers is sufficient. Our eastern neighbors, so discerning in all matters of interest, have also found out the secret of success in railroads for travel. In the New England States, even between points of but little comparative importance, the speed is higher than in any other part of the United States, and the fares are generally low—from two to two and a-half cents per mile. As a consequence, we find on some of the railroads radiating from Boston, even those to small towns, (the Boston and Worcester for example) a greater travel than exists between New York and Philadelphia, and a much greater than between Philadelphia and Baltimore. We need not add, that notwithstanding their great cost, and this was in many cases enormous, the New England railroads have proved in almost all cases profitable. If the New Englanders were in some cases wasteful and injudicious in the construction of their roads, they have certainly given to us, in the matter of fares, and in other respects, the most valuable lessons in their management.

The circumstance of the railroad fares generally in our country being too high, is perhaps ascribable to the fact of many of them having been adjusted in the years 1835, 1836 and 1837, and their not being since reduced to accommodate them to the enhanced value of the currency on its present specie basis, or the diminished cost of all the necessities and luxuries of life. Three dollars per passenger between New York and Philadelphia, and the same price between Philadelphia and Baltimore, by the old Camden and Amboy and Newcastle and Frenchtown lines, were fair enough rates for the times when they were established, but two dollars now would be equally high, taking into consideration the price of every thing, as three dollars then. Instead of this, the fares on the present railroad routes, are four dollars on

each route, or twice as high, considering the increased value of money, as they were originally, and twice as high as it seems to us they should be, consistently with the interests of the proprietors of the railroads, not to speak of that of the public.

Our opinion in a few words is in substance this: that between towns of any size and in populous districts, rates not exceeding two to two and a half cents per mile, will be found most advantageous to the companies, even in protected lines, or those where there can be no competition, by the great increase they occasion in the amount of travel. The care, it will be seen, is greatly strengthened, where, as in the case of the Philadelphia and Baltimore railroad, the line is *unprotected*, and nothing but a very reduced rate can prevent competing lines. A grave error, however, would be committed, were these rules misapplied, and extended to the case of sparsely settled districts, in which from peculiar causes, the laboring classes cannot travel.

Such is the case in the southern States of the Union. If railroads can be sustained in these, it can only be, unless in a few cases, by *comparatively high* fares, because the laboring classes being slaves, would in the one hand afford no aliment for railroads, however reduced the rate; and their owners, whose engagements would be mainly on their farms and plantations, and whose journeys are generally limited to one or two trips during the year, for the sale of their staples, would be but little influenced in the number of their trips by the rate of fare being higher or lower. We use the term *comparatively* high, because we would not be understood as recommending *high* fares even in the south. We have little doubt that even in the slave States, the rates of fare are generally higher than the most judicious rates would be, but they certainly could not, with a due regard to the interest of the companies, be placed at as low rates as would be advisable in the northern and eastern States.

With regard to speed, we hold, that the rates of speed cannot, within any tolerably safe limits, be too high for travel, or within any convenient limits, too slow for freight. Many railroads in our country are at this moment unproductive from want of attention to this simple truth.

In the transportation of freight, there will be nearly, or very nearly, equal accommodation to those making use of the road, whether the rate of transportation be seven or fourteen miles per hour, and the same price would probably be commanded for the transportation of produce and merchandize, at one as at the other rate of speed. But there would be this great difference to the railroad company, that with an engine properly constructed for freights, it could not carry at a speed of *fourteen* miles per hour even half the load in produce or merchandize, that it could at a speed of *seven* miles, while the wear and tear of the engine, cars, and superstructure of the road, and risk of accidents would, for a given tonnage, be increased at least four fold, by doubling the speed. The cost of transportation, therefore, so far as these elements of it are concerned, would be increased in much more than a corresponding ratio with the rate of speed, and would on roads on which

fuel was cheap, be probably *three fold* the amount per ton, *for a double velocity.*

We cannot, in the limits of this article, demonstrate these positions with minuteness, but professional gentlemen will perceive at once their correctness. The deduction is, of course, irresistible, that on most of the railroads in our country, a rate of speed for freight is still practised, greatly beyond what is judicious, and, of course, if the transportation of freight *is*, in such cases, the source of any profit now, the companies may look to the same business as a source of great profit, as soon as their freight transportation shall be conducted with engines properly constructed, at slow velocities.

We say, *with engines properly constructed*, because the locomotives now in general use throughout the country, though susceptible of great improvement for the transportation of passengers, are, many of them, on the worst possible plan for freights. They have the advantage generally of only *half* their weight on driving wheels. They can therefore carry at slow velocities but half the load, which with the adhesion of their whole weight they would be capable of transporting. In addition this half is usually on *two instead of four* driving wheels. The engine is consequently twice as heavy on each driver, and much more than twice as injurious to the road, even at a slow rate of speed, as a locomotive would be of the same weight, (but double the power,) equally distributed on eight wheels, so connected as to give to the engine the advantage of its whole adhesion. The engines of Winans, on the Western (Massachusetts) railroad are on this principel, but unnecessarily weighty and cumbrous, in consequence of the adoption in them of the vertical plan of boiler; in our opinion particularly misplaced in a long engine on eight wheels, because in such an engine it occasions the necessity of great strength, and unavailable weight, (*except* for adhesion) in a cumbrous frame. With a horizontal boiler, (no frame worth speaking of being required,) nearly the whole weight of the engine is in its boiler and wheels. A horizontal engine of given weight can of course have a proportionally increased capacity of generating steam.

That such engines as we have described, or some modification of them, will ere long be introduced generally on our railroads for the transportation of freight, we cannot doubt, and when they are, and transportation shall be effected by them at slow velocities, the public will be not less astonished at the greatly diminished wear and tear of both road and machinery than at the improved efficiency of the locomotive. Such an engine as we describe, of from ten to twelve tons weight, and, of course, not exceeding one and a half tons on each wheel, would draw with ease, over the Philadelphia and Reading railroad, a load of five hundred tons gross, or about three hundred and fifty tons nett, and with obviously little more injury to the road than if the cars were drawn by horses, for the simple reason that the weight on each wheel would only be about the weight on ordinary car wheels.

But if such great advantages are to be anticipated from the introduction of low velocities, with suitable engines for the transportation of freight, we must

look to the development of an opposite principle for the attainment of the highest success in roads for the transportation of passengers. In these, the object must be a proper system of police and the improvement of the engine for high, instead of low velocities. Valuable as time is in our country, any reasonable increase of speed on passenger roads is abundantly justified by the great increase of travel induced by it. The great intercourse between towns very near each other, is in a great degree ascribable to the increased relations which grow out of their contiguity, and the more near, of course, that distant points are brought to each other by railroads or by increasing the speed on them, the more they approximate to the case of contiguous towns, and the more their intercourse is increased. If the trip between Philadelphia and New York was, for instance, made in four hours, which, it seems to us, it might easily be, instead of six, we cannot doubt that the trips of men of business would be twice as frequent as they now are between those cities, even at the present rates of fare; for they could then with ease and comfort go from one town to the other, transact their business, and return by an early hour of the evening. The same would be the result of a higher speed between Philadelphia and Baltimore, points between which the intercourse must be greatly checked by the present very slow rates of travel on the Philadelphia and Baltimore railroad. If, in addition, between these populous towns, there was not only a greater speed, but a reduction of fare, the effect on the travel would, of course, be greatly enhanced.

And this increased speed, so valuable in the case of passenger roads, could not for a long time be attended with the same proportionally increased cost, which would be requisite in freight trains, for this obvious reason, that on *most*, if not all, the railroads in our country, it will be many years before full loads of passengers can be had on them for engines of ordinary power, and in consequence the power of the engine expended in going at a high rate of speed, would be wasted at a low speed. Without reference, however, to this consideration, it will be at once perceived, that the great increase of travel, induced by higher rates of speed, while there is no corresponding advantage in the case of freights, is the principal cause of the difference in the speed proper for freight and passenger roads.

This being the case, we trust that the same attention which is now being paid to the construction of engines of slow velocity for freights, will be given to engines for the mail and passenger transportation. Such engines should have driving wheels of a diameter materially greater than that proper for freight trains. While three feet at farthest, with our notions as to slow transportation, should be, in our opinion, the maximum diameter of all the wheels of freight engines, as well as the guide wheels of passenger engines, the diameter of the driving wheels of the latter, on roads of great travel, should not be less than five feet. Of course, every precaution should be taken that such wheels are accurately set on their axles, and the flaunches of both the drivers and front wheels of the engine should be sufficiently deep (say 1½ or 1¾ inches) to avoid any risk of the locomotive being thrown from

the track by any obstacle but one resting on both rails, or so elevated on one rail as to overturn it. With these precautions and a proper police in relation to the road and machinery, we are inclined to think that a speed of 25 miles per hour at least may be attained on most of our roads, without any increase of risk at all correspondent to the greatly increased travel which would result from such speeds.

As to the item of risk, it should be born in mind that for passenger transportation, every precaution should be taken, and with such precaution, it does not appear to us, that at the rate of speed before mentioned, there is any material risk. If the axles and wheels of cars are of good materials and abundantly heavy, and every part of the engine properly proportioned, and leaning to the side of unnecessary strength. If no engine or car is allowed to leave the shops of the company without being closely inspected, and without the slightest repairs which may appear desirable being effected, there is really very little risk in railroad travelling from any cause, but blundering management in the arrangement of trains, by which a collision may take place, or from the designs of malicious persons, who may place obstacles on the track. The former is so serious a matter, at even the slowest rate of speed which travellers would put up with, that it must be guarded against by legislative provisions, and the strictest discipline at all hazards. From the latter, (obstruction in the track,) there is no danger to passengers, even should the locomotive be thrown off, if the baggage car, or cars, are put in front of the passenger cars, and the simple expedient of wooden couplings is adopted, to connect the engine and tender with the trains.

The above views will, we hope, satisfy many of our readers of the correctness of our proposition, of the propriety of high speed for travel and low speed for freight. We may perhaps present some further considerations on the subject in a future number, with comparisons between results on routes on which the policy advised by us, or an opposite one has been adopted.

For the American Railroad Journal and Mechanics' Magazine.

NOTES ON PRACTICAL ENGINEERING.—No. 6.

Wharves.

Although some may consider the remarks on the present state of bridge engineering not quite just, few will deny that the wharves, even of the great cities, are wretched affairs, whether we regard their present state, or their original projection, if, indeed, they ever had any. The extent of the wharves in this country is immense, and though all, or nearly all, of wood, there is still abundant room for the exercise of engineering skill in their construction, as well as in properly adapting them to the materials and business of their locality. These, as well as bridges, enter largely into the practice of the engineers of Europe; and the state of the wharves in this country is the wonder, but not the admiration of foreigners, and, perhaps, still more so of citizens, who have spent some time abroad. It will, of course, require a long time to produce a general change, but might not a commencement be made by strennous exertions on the part of the profession?

The following account of the construction of a wharf for the northern terminus of the Champlain and St. Lawrence railway, and of the wharves at Monteal, may interest some of the readers of the Journal. The former runs out one-fourth of a mile into the river, is 32 feet wide, and ends in a T, with 200 feet front. A single track is laid on one side, the other side being required for carts and passengers. On the face of the T there is a wide platform for freight, and on the upper side of the wharf piles are driven at a distance of about 8 feet, and on these and on the edge of the wharf lumber is piled, so as to be ready for the cars without interfering with the traffic. On the approach of winter, the platform, turntables, office, etc. are removed, but the track is left, being secured to the timbers of the wharf. Ice soon forms in that climate, the river rises rapidly above the wharf which is under water from the beginning of December to the end of April, when the ice

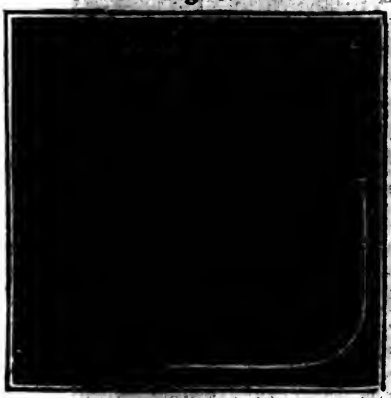
Fig. 1.

dams below give way and the water falls in a few hours to its ordinary level. The piles to which the steamboat is moored, and which serve as fenders also, are drawn by the rising of the ice, they are then cut out, taken ashore, and driven again the following spring.

The transverse section, fig. 1, shows the mode of construction. The sides are formed of horizontal courses of white pine with a batter of 2 inches to the foot rise, the ties are of round tamarack below water and of white cedar above, they are 10 feet apart, 8 inches square at the outer end and let 4 inches into the superior and inferior courses. The face timbers are further secured by a piece of ¾ inches square iron, ragged, 3 feet long driven into a ¾ round hole, each 10 feet of each course. Ties break joints, not as in brick work, but by steps, as it were, so as to offer their entire surface to the slate with which the wharf is filled to the dotted line, fig. 1. The side or face timbers are capped with an oak plate, and on the T they are further steadied and secured by a block and strap firmly bolted to the ties and face timbers as seen in fig. 2. The face of the wharf is planked. The upper end of the planks are let 2 in. into the oak plate. as seen in figs. 1 and 2, and their feet are kept in place by the outer sill, which will be readily understood by the "plan" of the lowest course, fig. 1. The inner ends of the ties are dove-tailed into the middle longitudinal timbers, which are merely flatted, and of the cheapest kind of wood. The corners of the T are arranged as in fig. 3, which is a plan of the upper course with the oak plate removed. The face timbers lap at the corners, they are rounded off by a piece of oak, which with 3 or 4 of the plank, also of oak at this point, are firmly held in their places by iron straps bolted to the timbers, and also to a pile driven into each corner of the T. The foot of the oak corner timber is nearly triangular in section, and just fills the space between the face timbers and the outer sills, which are also lapped. After eight years exposure, these corners remain as at first. The wharf was commenced at the shore and

Fig. 2.

Fig. 3.



carried out 1200 feet in one continuous mass of timbers, the T was sunk at the end of the wharf, and held in its place by piles; the timbers above the level of the water are also continuous with the upper timbers of the wharf.

The river front of the city of Montreal is protected and adorned by a superb quay of cut lime stone, about 20 feet high, a mile in length and with numerous carriage ways leading down to the wharves. These are formed of piles of white pine about 14 inches square, driven at a slope of about 2 inches to the foot. They are grooved on the two edges so as to receive an oak tongue about 3×4, and are secured at the top by a heavy wale timber, at the back with blocks, ties and straps very nearly as in fig. 2, the face timbers of which occupy the place of the piles. The corners are rounded off very gently, which I think a mistake, as it sacrifices much room, and is in other respects inconvenient. A heavy iron strap is carried along the face at low water. The workmanship is unexceptionable, and the wharves might serve as models but for one defect, which would have been avoided had the plan been submitted to any competent engineer. The distance between the wale at the top and the bed of the river must be more than 20 feet, and the pressure from the filling in has caused the piles to bulge out, and in some cases has actually forced an opening between them. The wharves are under water several months, and when the river falls rapidly the outward pressure from the saturated mass must be immense. The effect of this thrust, though it could not escape the attention of the engineer, was naturally enough overlooked by the commissioners and the respectable builders employed by them. Except in very extreme cases there can be no difficulty in guarding against this thrust, and in many instances this mode of constructing wharves will be found very advantageous. A strong current is no very serious difficulty, and an uneven bottom, or one liable to wash—to a considerable extent—are no objections. The timber is in the best position for durability, and the piles may be bored down to the level of the water and filled with oil, tar or any other preservative. Had the present steam pile drivers been in use in June, 1835, I believe I should have adopted this mode of construction for the railway wharf. When in Montreal, in 1842, I perceived that they were building a new wharf of crib work, which was attended with some difficulty, on account of the slope of the river bank producing a tendency in the crib work to slide into the channel. They had even constructed a rude coffer dam to aid their operations, and after all it will be inferior to a piled wharf where the thrust is properly guarded against.

The wharves of the Reading railway are said to be admirably arranged, but I am unable to speak from observation of their merits in this respect, or of the mode of construction. The wharves described above are the best specimens of crib work and filling which I have met with, though like all other structures admitting of endless variety and improvement.

W. R. C.

New York, April, 1844.

We desire to make our acknowledgements to J. Williams, Esq., treasurer of the Boston and Worcester railroad company, for a copy of the "Annual Reports of the Railroad Corporations, in the State of Massachusetts," as made to the legislature, giving a statement of their operations for 1843. The reports of the different companies, like the works to which they refer, are got up in a style commendable to those who manage those companies. It was our intention to have given in this number a synopsis of them, with our annual comparative table, showing, at a glance, what each has done during the past year—but other avocations have prevented, and it is defered until the next number.

INDIANA RAILROAD REPORT.

We find in the Indiana State Sentinel of March 5th, the report of the Madison and Indianapolis railroad company, which we give at length, that our readers may know what is going on in the west. This report shows a very favorable and progressive state of affairs, and must stimulate those interested in the work to renewed efforts for its speedy completion. We find in this report a beautiful illustration of the advantages of *long*, over *short*, railroads. The rapid increase of receipts per week, when a new section of the road was opened for use, even though but a few miles in length, shows conclusively that as our railroad system is extended, and different roads are connected with each other, the business will increase almost in a geometrical ratio, and that roads which now scarcely pay expenses, will become profitable works, and good investments. We shall be gratified to record the completion of this road to Indianapolis, and *then* its continuance to Lafayette and lake Michigan. Accompanying the report is a statement showing the details of the freight transportation during the year.

To the directors of the Madison and Indianapolis railroad company:

One year having elapsed since the company took possession of the State's portion of the road, and since I have had the superintendance of all the affairs of the company, I deem it necessary and appropriate to lay before the board of directors as full a statement of the operations of the road, both as to transportation and construction, as circumstances will enable me and a proper understanding of the affairs and finances of the company may seem to require.

At the time the company took possession of the State's portion of the road and the consequent charge of the operations in transportation, the cars were running a distance of 28 miles, to Griffith's. Owing to the severe weather which continued to a late period in the spring of 1843, the road was not completed to Scipio until the 1st of June, at which time the cars commenced running to that point, being an extension of only three miles; at this point the northern terminus of the road continued until the 1st of September, a period of three months. On the 1st of September we extended the running of the cars to Elizabethtown, a distance of seven miles from Scipio, and ten miles from Griffith's. On the 1st of February we commenced running the cars to Clifty, being a further extension of 4½ miles, and to a point about 2½ miles south of Columbus, making an entire extension of the road complete, 14½ miles north of Griffith's.

The further completion of the superstructure to Columbus is in progress,

being so near completion as to secure the expectation that we may run the cars to that point in the course of the next two months.

Under authority of an order of the board, I contracted in August last with Mr. John McNickle, of Covington, (Ky.) for 180 tons of railroad iron, being a quantity, estimated sufficient to iron the road to Columbus. Of this iron, 110 tons have been delivered and mostly laid down. The balance, according to contract, is to be in readiness by the time the superstructure is prepared for it. For this iron, acceptances have been given for the first fifty tons, at 4 months—for the next fifty tons 6 months, and for the remaining portion at 5 months from the periods of delivery respectively. The acceptances have been made by drafts drawn by me, as treasurer of the company, on, and accepted and endorsed by gentlemen friendly to the road, who have lent their names to the company to aid in procuring the iron.

The progress of the contractors for building the superstructure between Columbus and Edinburg has been tardy, but not more so than could reasonably be expected. Considerable progress has, however, been made, and if some additional aid could be rendered by substituting more available means, we might hope to have the superstructure complete to Edinburg in the course of the next autumn.

The survey and estimate of that portion of the line of the road between Edinburg and Indianapolis, which was completed last summer, shows that the grading and bridging of this part of the road will cost much less in proportion to distance, than that portion south of Edinburg. The whole estimate for grading and bridging the 30 miles being only $96,500. The operations in the repairs of the road in use have been steadily in progress, but have been limited and confined to such repairs and improvements as seemed indispensable to the preservation of the embankments and superstructures, and such other work as was necessary to the successful operations on the road and the safe running of the cars.

This limitation was in a measure imperative from the necessity of meeting the company's obligations on paper given for iron, and on which various persons had kindly lent their names as security, and which every honorable consideration to them, and preservation of the credit of the company required should be promptly met. Had abundant means been at command, a more extended operation in repairs might with propriety have been gone into; but none has been neglected which a proper regard for the preservation of the road required. Much more has been done in this regard than had been performed the previous year while under the care of the State, and the condition of the road is as safe and favorable for the running of the cars and the general operations of its business as when the company took possession of it; and the preservation of the superstructure is much better secured, in that portion at least, which relates to the bridges.

A permanent depot has been completed at Madison, at a cost of nearly $1,200. Others of a cheap character have been provided by the lessors at Scipio and Elizabethtown, and a temporary one at Clifty, at the expense of the company; all of which have been necessary for the accommodation of the business of the road. The receipts from transportation and passengers have been favorable and have met my anticipations suggested to the board on a former occasion, although our charges on many articles of freight are too low. The receipts could not be expected to increase much while the road was unextended, and, indeed, as our charges were 25 per cent. below those charged by the State, it should not have surprised us if there had been a falling off in the receipts for the three months, and over, that we remained at Griffith's, but there has been a gradual increase in the business and re-

ceipts of the road; increasing greatly as it has been extended; the weekly receipts running up from $240 to near $1000, and the business accumulating beyond the means of our motive power to perform. The receipts for transportation and passengers for the 3¼ months that our northern terminus remained at Griffith's, averaged $270 per week, and for the next three months while we were at Scipio, (an extension of three miles only) the weekly receipts averaged $400, and for the succeeding 5 months, our northern terminus being at Elizabethtown, (a further extension of seven miles,) the weekly average receipts were $550, and since we have extended the running of the cars to Clifty, a further distance of 4½ miles, we find that additional engines and cars are required to do the work, and our receipts running from 800 to over 1000 dollars per week.

This fully illustrates the certainty of greatly increased business as we extend the road into the interior. The ratio of increase in business will be equal to the square of the distance of each extension. These facts and considerations should, it seems to me, encourage the friends of the road and all interested, (and all on the line or within available distance of it, and all interior Indiana, are deeply interested,) to persevere in efforts to carry it through.

The total amount of receipts, exclusive of railroad scrip, from the 20th February, 1843, to the 3d February, 1844, have been $24,385 17 of which the sum of $22,110 33 were receipts from transportation.

The remainder were receipts on stock subscriptions and miscellaneous. The receipts for the unexpired portion of the year since the company took possession of the road will probably swell the receipts from transportation to $24,250.

At the period of our taking charge of the road, I signified my belief that the receipts from transportation would, with the other funds then on hand in State scrip, be sufficient to meet the demands against the company on the first iron contract, within one year from that date. This expectation has been fully realized, but the diversion given by the board to a portion of the receipts together with the necessity of paying for spikes, iron, freights, etc., has left a small portion of that debt yet unpaid; say about $1500, but a portion of this will still be discharged out of the receipts accrued within the year. There has been paid out of this fund set apart to meet this iron contract an amount larger than the unpaid residue of the iron debt. The contract with Col. McNickle for 180 tons of iron for extending the road to Columbus, will, including iron for spikes, call for the payment of about $11,000 to be paid on acceptances as suggested in a former part of this report, the means for which, I have no doubt, will be realized in the receipts for transportation in time for the maturity of the paper.

The required amount anticipated for the current expenditures for road repairs, cars, etc., will doubtless exceed, by a considerable sum, the outlays for the same purposes for the past year, but the greatly increasing business and consequent receipts from the road, it is presumed will cover such additional expenditure, except the purchase of an additional locomotive engine, which I deem indispensable, and respectfully recommend the board to authorize to be procured if means can be devised for its purchase.

I have, in pursuance of the order of the board, contracted with Messrs. W. N. Jackson and John D. Morris for the building of a suitable depot at Columbus; a duplicate of the article of agreement is on file in the office, and will be submitted to the board.

The main portion of the deeds given the company for lands subscribed, have been sent to the proper counties and recorded; an account of the expense of which will be submitted to the board.

I deem it due to the several officers in the service of the company, as well as the hands employed in the various departments, to testify to the industry and fidelity of each and all, and that during the great press of business for the last few months they have been subject to severe labor and exposure which they have gone through with cheerfulness and alacrity.

The greatly increased business of the road will require, without delay, some more efficient means of transportation over the plain at the Madison hill. The tardy and expensive mode now employed, together with the still more injurious results of delay, unavoidable in the present mode, render a change in this respect extremely desirable if not indispensable. The employment of a locomotive engine adequate to the business of the road, would save, in money and time, which is precious, an amount equal to its cost in a short time, besides other important advantages that would result from its adoption. The condition of the slip at the plain is not at this time safe for the use of such an engine, but this, however, could be placed in a suitable condition by the time the engine can be procured. The amount of debt contracted by the last purchase of iron will require the nett income of the road for the main portion of the year to discharge it, and of course no considerable amount can with propriety be calculated upon from that source for the purchase of an engine. But if the nett proceeds of the road for a period beyond the payment of the present iron debt, can by any means be anticipated, it seems to me that the engine should be ordered forthwith.

The remarkable weather which has visited us for nearly the whole time since the company has been running the cars, has been alike unfavorable to road repairs and to the business of the road, while its effects upon the embankments, cuts and foundations have been such as should be expected from the constantly wet condition of the earth.

This has been equally unfavorable to the running of the trains; the track being, much of the time, so slippery that the engines could not take over the road more than one-half to two-thirds of the tonnage that can be taken in favorable weather. Yet with all these difficulties an amount of business has been done (as will be seen by the tabular statements) far beyond any previous year, and repairs have been made also to a larger amount.

With obstacles thus difficult and opposing, and with a tariff of charges, on an average at least 25 per cent. below that charged by the State, the receipts from transportation for the year ensuing the time of our taking possession of the road will have amounted to rising $24,000, not in outstanding and unavailable debts, but in actual cash receipts. The nett proceeds of the road, after deducting the rent to the State, will not vary much from 10 per cent. on the capital stock of the company paid in; which amount will be subject to division among the stock, to be carried to the credit of the stockholders as so much additional stock, agreeable to the consent in writing of most of the stockholders on file in the office, or to remain as a surplus to be hereafter divided

But if the board should deem it advisable to declare a dividend, I would recommend that it should not exceed 8 per cent., leaving an overplus for future disposition.

Statements will be exhibited to the board for its information, showing the general state of our finances, and the amount of receipts and disbursements under each appropriate head, together with tables showing the state of my account with the company as its treasurer, to which I invite a searching scrutiny by the board.

Believing the taking proper care of money when earned, as important as to earn much, I have carefully watched the operation of our system of ac-

countability, and checks, and balances, and have examined the waybills and collated and compared the results with the weekly statements of the clerks of transportation and conductor, upon which these payments are made to the treasurer, and find that the system, though not perfect, is, if fully carried out, sufficiently guarded for the protection of our funds, and which is further secured by honest and faithful officers, having charge of the departments of transportation.

This being the first year of the company's operation in transportation and control of the road, much interest has been manifested by the stockholders and the public as to its management and probable results which would flow from an extension of the road, both as to its own revenue and utility to the public. The practical illustrations which have resulted from this one year's experiment, in our system of management, accountability and economy, together with the certain favorable effects of the extension of the road on its business and revenue, should be highly gratifying and encouraging to all the friends of the road; and although this great undertaking (so far as the company is concerned,) is in its infancy, yet we have good reason to hope that the ultimate results will be alike propitious in profit to the shareholders and general utility to the community.

In the management of a business so large as is now commanded by this road, and where every interest, so far as regards the details of its management, is antagonistical to the interest of the company—added to the fact that some delight in, and are incessant in manufacturing clamor, it could not but be expected that complaints would be made; but so far as these several conflicting interests have depended upon my action, I have carefully consulted my best judgment, and when convinced of the right and proper course, I have carried it out, as I hope, with firmness and moderation, and hold myself responsible to the board and to the stockholders for my action as their agent and representative. All of which is respectfully submitted.

Madison, Feb. 22, 1844. N. B. PALMER, *President.*

The following table will show the amount and quantity of the several articles of freight (inward bound) or going south, which passed over the railroad from the 20th of February, 1843, to the 3d of February, 1844. A statement of the outward bound freights, together with other interesting tables, will be shortly published, but which are not at this time in perfect readiness.

2,340	through passengers,	1,328	flour barrels,
2,974	way "	31½	bushels barley,
402	hhds. bacon,	87½	bushels grass seed,
243,763	bacon and bulk pork,	20,324	hoop poles,
15,038½	bushels wheat,	489	bushels potatoes,
5,570	bbls. flour,	18	head cattle,
260,918	lbs. miscellaneous freight,	281	head horses,
1,382½	bushels flaxseed,	256	bbls. whiskey,
1,956	kegs lard,	2,211	pork barrels,
1,157	bbls. lard,	23,277	pounds furniture,
1,981	bbls. pork,	868	lard kegs,
1,153	cords wood,	325,286	feet poplar lumber,
210,692	pounds hay,	4,535	feet ash and cherry do.,
17,376	live hogs,	92	car loads staves,
483	slaughtered hogs,	11	perch stone,
11	bushels corn,	89½	thousands shingles,
43,838	pounds hemp,	365	bacon hhds.,
254,306	pounds tobacco,	18	carriages,
158	bushels meal,	757	bushels oats.

The following description of preparing the speculum for a large telescope will be found interesting to many of our readers. It is taken from the February number of "The Civil Engineer and Architect's Journal."

LORD ROSSE'S TELESCOPE.

At a meeting of the Belfast Natural History Society, the steps by which difficulties were overcome in making the speculum, were explained by Mr. Stevelly in detail, under the following heads:

METAL FOR THE SPECULUM.—The metallic alloy for the speculum consists of four atoms or chemical combining proportionals of copper to one of tin, or by weight 126·4 copper to 58·9 tin. This alloy, which is a true chemical compound, is of a brilliant white lustre, has a specific gravity of 8·811; a twelfth of a cubic foot, or 144 cubic inches of it, weighing, therefore, a little over 45¼ lbs. avoirdupoise, or to allow for all waste when casting, 50 lbs. which is the rule by which Lord Rosse estimates the weight of metal he requires. This alloy is nearly as hard as steel, and yet is almost as brittle as sealing wax. Of this most unpromising material Lord Rosse has cast, ground, and has ready for polishing, a circular mass, 6 feet in diameter, 5¼ inches thick, and weighing upwards of three tons, with a surface perfectly free from crack or flaw, and quite homogeneous. The next head is

CASTING.—On the first castings having flown into pieces, finding that the fragments no longer fitted each other in their former places, he perceived that they had been in a state of violent strain arising from the cooling and setting of the outer parts, while the inner parts, yet fluid, were also largely expanded by the heat; this, and the porous surface, led him by many stages and trials to the remedy, which is simple and complete. The bottom of the mould is made of a ring of bar iron, packed full of slips of iron hoops set on their edges, which lie in parallel cords of the ring. These, though packed very tightly together, and so closely fitting that the melted metal cannot run between them, yet allow any air that is carried down to the bottom of the mould when the metal is cast in, to pass out through the interstices. After the ring is packed, it is secured in a lathe, and the face, which is to be the bottom of the mould, turned true to the convex shape to fit the concave speculum required. It is then placed flat on the ground by spirit levels (between the surface in which the metal is melted, and the annealing oven,) and the mould completed at the side with sand, in the way practised by founders, but left open at the top. The metal is then melted in cast iron crucibles; wrought iron would be corroded by the speculum metal, and injure its properties, while fire clay crucibles will not answer. Unless the crucibles be cast with their bottoms downward, they will be porous, and the metal alloy will run through their fine pores. When the metal is melted, and still much too hot to pour, the crucibles are brought by a crane, and set firmly, each in a strong hoop iron cradle, which turns on gudgeons, and so arranged round the mould that when the handles of the cradles are depressed, they pour out their molten mass direct into the mould. An oxide forms rapidly on the surface of the metal while too hot—this is as rapidly reduced back to the metallic state by constantly stirring it with a pine rod; as the temperature sinks, the instant this reduction of the oxide begins to cease, is seized on as the proper moment for pouring. The liquid mass descends with a few fiery splashes, and after waving back and forward for a few seconds, the surface becomes still. The setting process begins at the hoop iron bottom, where a thin film first sets—the process extends upwards in horizontal layers, and at length the top, though red, becomes fixed in form; the mass is then as tough as

melting glass, and being turned out of the mould upon a proper truck, with the face upwards, is drawn into the oven to undergo the process of

Annealing—or very slow cooling. Here it is built up into the oven, previously heated red hot, and fire is kept up under the floor of the oven for some days; the under fire places are then stopped, and all left for weeks to cool down to the temperature of the air. The six feet speculum was left here sixteen weeks. Here the particles of the alloy slowly arrange themselves into the arrangement in which the aggregating forces are in equilibrium, or natural and equal antagonist tension. When the oven is opened, the speculum is removed to the workshop, to undergo the process of

Grinding—which process was illustrated by working a model. In the workshop it is placed on a circular table, in a cistern filled with water, of temperature, say 55° Fahrenheit, with the face to be ground upwards. The circular table is turned round by the motion of the grinding engine. But first, the edge is made truly cylindrical by being surrounded by many pieces of deal board set in an iron ring pressing against the edge; emery being introduced as it turns round, soon grinds it cylindrical; it is then placed in the box in which it is to be used; here it is firmly secured by a ring of iron brought to embrace, firmly yet gently, its now truly cylindrical edge. The box and speculum, with the face to be ground placed upwards, is now again placed on the circular table in the cistern of water. Emery and water being placed upon it, the grinding disk is laid on, which is a cast iron plate turned at one surface to the shape to fit the speculum when ground, and grooved on that surface with many annular grooves concentric with the plate, and with many straight grooves running across at right angles to each other. The back of this grinding plate is ribbed with six or eight radial ribs, to give it stiffness. This plate sits rater loosely in a ring of iron a little larger in diameter, which is driven back and forward by the motion of the steam-engine. This ring has two motions, longitudinal and transverse. The engine causes it to make 24½ strokes for one turn of the speculum on its axis under the grinding disk, about 80 strokes taking place in a minute; the length of this stroke is one-third of the diameter of the speculum. The motion is produced by an eccentric pin. The transverse stroke takes place 1·72 times for each turn of the speculum, and its extent is, at the centre of the speculum, $\frac{27}{100}$ of the diameter of the speculum; it is produced by an eccentric fork. A fourth motion takes place by the grinding disk, while for an instant free of the ring, at the turn of the eccentrics, being carried round a little by the speculum, on which it is then lying as it were free; this causes it to turn once for about 15 turns of the speculum. Emery and water being constantly supplied, the surfaces of the grinding disk and speculum in a few hours grind each other truly spherical, whatever be their original defects of form. The process is finished, when, upon drawing off the grinding disk with one steady long pull, the surface of the speculum is left every where uniformly covered with the fine emery arranged in uniform lines, parallel to the line in which the disk was drawn off. A slight polish being now given to the speculum, its focal length is tested by a very simple process. The floors of the loft above the workshop, in the tower of the castle, contain trap doors, which are now opened, and a mast erected on the top of the tower, which carries at its top a short cross arm, to the under surface of which a watch dial is fastened, the face of the dial looking down on the speculum, now directly under it, and at a distance of 97 feet. A temporary eye piece erected in the upper floor of the tower, soon finds the place of the faint and still imperfect image of the watch dial, the proper place of which is a matter of simple calculation, if the speculum be ground to the expected focus.

If it be found incorrect, the grinding disk is rendered a little more flat, or a little more convex, and the grinding process is renewed, and so on, until the spherical face of the speculum is given its proper length of radius. When this is accomplished, the brilliant reflecting surface, and true form for producing a good image, is given to the speculum by the final process of

Polishing.—In this, two matters require attention, the polishing powder and the surface of the polisher. The powder used by Lord Rosse is not putty or oxide of tin, as used by Newton and his followers, but red oxide of iron procured by precipitation from green vitriol or sulphate of iron by water of ammonia; this is to be heated carefully in an iron crucible, for it has a tendency to take fire, and thus run many particles into one, and render the polishing powder too coarse. The surface of the polisher used by Newton was pitch in a very thin layer. Instead of pitch, which Lord Rosse found too full of gritty impurities, he uses resin tempered with spirit of turpentine. A large quantity of resin being melted, the spirit of turpentine is poured in, and well mixed and incorporated (about a fifth by weight suffices.) The proper temper is known by taking up a little on an iron rod, and putting it into the water until it acquires the temperature, say of 55° Fahrenheit. Then if the thumb nail make a slight but decided impression, it is rightly tempered; if not, more resin or more spirit of turpentine is added, until the proper temper is attained. The tempered resin is now divided into two parcels; to the one parcel a fourth part (by weight) of wheaten flour is added to give it tenacity and diminish its adhesiveness. This is incorporated by stirring until it becomes clear. To the other parcel an equal weight of resin is added, which makes it very hard. Upon this, when cooled to 55°, the nail will scarcely make an impression. The grinding disk, with its spherical surface turned upwards, is now heated by fire underneath, and the resin rendered tenacious by flour laid on with a brush in a thin even coat about 150° Fahrenheit. This coat and the grinding disk are then allowed to cool down to about 100° Fahrenheit, when a thin coat of hard tempered resin is laid on as evenly and thin as possible. The smooth ground concave speculum is now covered with a creamy coat of the fine polishing powder and water, and the warm polishing surface turned down upon it at about 80° Fahrenheit, when it soon takes the form of the speculum as in a mould; care must be taken not to put on the polishing plate too hot for fear of cracking the speculum, which the interposed creamy polishing powder helps to protect; nor too cold, else it will not take the proper figure. The grinding engine now gives the same motions to the polishing plate as before, but its weight is much diminished by counterpoising it. The soft tenacious coat below, and the grooves on the surface of the grinding disk, permit the proper lateral expansion, while the hard outer coating retains its form, and holds firmly embedded the particles of polishing powder. The polishing now proceeds rapidly, and as soon as what is technically called the black polish is attained, the defining power is judged of by examining the minute divisions of the image of the watch dial under an eye piece of high power. The true form is known to be given as the polishing proceeds, if the focal length slowly increases in a tabulated proportion to the time. The six foot speculum it is expected will be finished after six hours' polishing.

An Enormous Steam Engine—by far the largest ever constructed—is now in process of manufacture at Harvey and Co's. foundry, Hayle; the piston rod, which was forged last week, is 19 feet long, 13 inches diameter in the middle, and 16 inches in the core; and weighs 3 tons 16 cwt. It will work in an 80 inch cylinder, which will stand in the middle of another cyl-

inder, of 144 inches diameter. Five other piston rods will work between the inner and outer cylinders. We conclude, for this has not been explained to us, that the piston of the external giant cylinder will be perforated in the middle for the 80 inch cylinder to stand in it, and will work between the two. The 80 inch cylinder was cast last week, and the large one will be cast soon. The pumps are to be 64 inches in diameter; a measurement which may afford some idea of the size of the engine. It is intended for draining Hærlem lake, in Holland, and it is expected that other orders for similar engines will be received from the same quarter. It is truly gratifying to us to observe that Cornish engineers still keep so far in advance of all the world, and not less gratifying to see that foreign powers know and can appreciate their excellence. Let this wonder of engineering and mechanical skill be considered, as well as the duty done by our common mine engine; and it must be confessed that our Cornish mechanics are, in this branch, far in advance of every competitor; and we may reasonably hope, as superior merit must be appreciated at last, that our engine foundries will at length have their full share of public and government patronage.

Bothway's Iron Blocks.—An experiment has been made in Plymouth dockyard, to try the comparative strength of Mr. Bothway's single metal blocks against the rope it is calculated to take, viz., a 3 inch one. A rope of that size was rove in the block, and one end brought to a windlass, and hove on until it broke. A 3½ inch was then tried; though larger than required for such a block, this also gave way; and the last is considered by practical men fully equal to the powers of an 8 or 9 inch block. The iron blocks have also another great recommendation in doing away with the rope strappings, as many serious accidents have occurred by their breaking.—*London Mech. Mag.*

Street Sweeping by Machinery.—The first exhibition in the metropolis of the self loading cart, or street sweeping machine, which has for some time been in use in Manchester, and is fully described in the "Mechanics' Magazine," No. 1014, took place recently on the wood pavement in Regent street, and attracted crowds of persons to view its very novel apparatus. The cart was drawn by two horses, and attended by a driver, and as it proceeded caused the rotary motion of the wheels to raise the loose soil from the surface of the wood, and deposite it in a vehicle attached to the cart. Proceeding at a moderate rate through Regent street, the cart left behind it a well swept track, which formed a striking contrast with the adjacent ground. It filled itself in a space of six minutes, its power being equal to that of forty men, and its operation being of a three fold nature—that of sweeping, loading and carrying at the same time, which under the old process formed three distinct operations.—*Ibid.*

A Handsome Present.—The little steamer built by Mehemet Ali to send as a present to the Sultan, is a most splendid little vessel, furnished in a most costly style. The cabins are entirely built of rosewood and mahogany, with silver columns, and rich satin curtains covered with gold. She is schooner rigged, and the masts are all of solid cherry wood. The engines are of thirty-six horse power, and there is no doubt that she will be a most acceptable gift to the Sultan as a pleasure yacht.—*Herapath's Journal.*

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